

APPLICATION FOR
UNITED STATES PATENT
SPECIFICATIONS

TO ALL WHOM IT MAY CONCERN

Be it known that I, Miguel A. Timm, a citizen of the United States of America and resident of the State of Texas, having a postal address of 17319 Cypress Spring Drive, City of Spring, County of Harris, State of Texas, have invented a new and useful "SELF-CONTAINED ELECTRONIC PRESSURE MONITORING AND SHUTDOWN DEVICE" of which the following forms the specifications.

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"SELF-CONTAINED ELECTRONIC PRESSURE MONITORING

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AND SHUTDOWN DEVICE"

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CROSS REFERENCE TO RELATED APPLICATIONS

Not applicable

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STATEMENT REGARDING FEDERALLY

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SPONSORED RESEARCH OR DEVELOPMENT

Not applicable

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BACKGROUND OF THE INVENTION

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The present invention relates to the field of industrial safety to shutdown a process or flow when the fluid reaches an unsafe pressure. In the event of detecting an alarm condition the invented device will provide a pneumatic or hydraulic signal to cause a safety shutdown.

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DESCRIPTION OF RELATED ART

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As shown in the reference U.S. Patents Numbers 6,276,135; 5,213,133; 4,616,670 and 4,485,727 the prior art has an abundance of diverse process shutdown systems.

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While the prior art inventions are adequate for the basic purpose and function for which they have been designed, they fail to provide a simple, reliable and ergonomic device that monitors the process' pressure and initiates shutdown when the sensed pressure falls out of the preset limits. A number of the prior art devices have sliding seals that are prone to become frozen after some time because of lubricants

drying out, creating the need for frequent preventive maintenance by highly specialized instrumentation personnel. Another type of device seen on the prior art resorts to bourdon tubes that directly control pneumatic valves which leads to very delicate mechanisms, expensive and prone to failures.

Adding to the above disadvantages, some of the devices shown on the prior art have just one alarm point, creating the need of two separate devices to protect against high and low pressure conditions. Furthermore, the operators have little means to know the mechanical conditions of the shutdown device, as they do not show any activity until an abnormal pressure is detected.

As consequence of the above there is a need for a better mean to sense pressure and provide a simple and reliable safety shutdown device for unattended installations to protect them when the pressure reaches unsafe limits.

BRIEF SUMMARY OF THE INVENTION

The Self-Contained Electronic Pressure Monitoring and Shutdown Device provides the means for a safety process shutdown that is reliable, needs minimal maintenance and provides the operator with direct reading of the process' pressure as well as the high and low pressure settings. Also, it provides a flashing lamp for each specific cause of shutdown and the means to recall the last cause of shutdown after the device has been reset. The invention is constituted of a Switch-Gauge (1) (a pressure gauge with electric contacts for high and low pressure alarms), an Electronic Logic Circuit (2), a Power Module (3), a Pulse Driven Solenoid Valve (4), a "High Pressure" indicator lamp (5), a "Low Pressure" indicator lamp (6), a "Low Battery" indicator lamp (7), a "System OK" indicator lamp (8) a "Reset" momentary switch or pushbutton (9) and a "Test" momentary switch or pushbutton (10). In essence the system uses the Switch-Gauge (1) to sense the high and low pressure conditions and when an abnormal pressure is detected the Electronic Logic Circuit (2) sends one or more consecutive "shutdown" pulses to the Pulse Driven Solenoid Valve (4) which controls a pneumatic or hydraulic signal that initiates the shutdown.

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55 BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

56 Fig. 1 is a schematic illustrating the general arrangement of the Self-Contained
57 Pressure Monitoring and Shutdown Device.

58 Fig. 2 is a schematic illustrating the interconnection of the battery cells of the Power
59 Module (3).

60 Fig. 3 is a schematic illustrating a battery-less alternative for the Power Module (3-A).

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62 DETAILED DESCRIPTION OF THE INVENTION

63 The device is composed of a Switch-Gauge (1), Electronic Logic Circuit (2),
64 Power Module (3), High Pressure indicating lamp (5), Low Pressure indicating lamp
65 (6), Low Battery indicating lamp (7), System OK indicating lamp (8), a momentary
66 switch or pushbutton "Reset" (9) and a momentary switch or pushbutton "Test" (10).

67 When operating under normal conditions, the contacts in the Switch-Gauge (1)
68 remain on their normally open condition and the Electronic Logic Circuit (2) remains in
69 a routine of continuously scanning the input signals and periodically reading power
70 voltages. The sign of life in the system is that the "System OK" lamp flashes every one
71 or two seconds to show the operator that the system is working and no abnormal
72 conditions have been detected.

73 If one of the contacts in the Switch-Gauge (1) goes from its normally open to a
74 close condition (alarm), the Electronic Logic Circuit (2) confirms the alarm by re-
75 scanning and re-confirming it for about one second before taking action. Once the
76 alarm is confirmed, the Electronic Logic Circuit (2) generates one or more consecutive
77 shutdown pulses to trip the Pulse Driven Solenoid Valve (4), causing the shutdown of
78 the process. The subsequent shutdown pulses are for redundancy to insure that
79 action is taken.

80 It is to be noted that the Electronic Logic Circuit (2) can be jumper-configured by
81 the operator in the field to have a pre-programmed time delay (i.e. 15 seconds) before
82 responding to a high or a low pressure condition. The time delay can be configured
83 independently for the high or the low-pressure alarm and it allows the system to ignore
84 temporary pressure excursions, as those excursions may be normal in some
85 processes.

86 If a shutdown would occur the Electronic Logic Circuit (2) flashes de
87 corresponding alarm indicator lamp to display the specific cause of it. The alarm
88 indicator lamp will continue to flash even if the Switch-Gauge (1) contact goes back to
89 normal or other alarm is sensed in order to insure that the cause of the shutdown is
90 made known to the operator when he arrives to the location. The device will continue
91 to display the condition causing the shutdown until the operator presses the "Reset"
92 momentary switch or pushbutton (9).

93 When the "Reset" switch or pushbutton (9) is pressed the alarm lamp turns "off"
94 and the Electronic Logic Circuit (2) pulses the Pulse Driven Solenoid Valve (4) back to
95 "Open" to allow the process to resume. Also, after the device is "Reset" by the operator
96 the Electronic Logic Circuit (2) will ignore any alarm that may be present for a pre-
97 programmed period of time (i.e. 30 minutes) to allow the process to return to normal.
98 If the alarm continues to be present after that period of time the Electronic Logic Circuit
99 (2) will initiate shutdown again.

100 If the device detects that one of the battery voltages is reaching below a pre-
101 programmed level, it will blink the Low Battery Voltage lamp (7) instead of the System
102 OK lamp (8) to alert the operator that it is time to replace the batteries. If the batteries
103 are not replaced within reasonable time the voltage will eventually fall below a pre-
104 programmed "low-low" level the Electronic Logic Circuit (2) will initiate shutdown as the
105 low voltage will compromise the device's reliability.

106 The Power Module (3), as shown in Fig. 2 is constituted of a number of battery
107 cells, such as lithium batteries and provides two voltages, a low voltage (i.e. 2.2 to 5.5
108 VDC) for feeding the Electronic Logic Circuit (2) and a separate high voltage (i.e. 6 to

109 30 VDC) to feed the driver circuits of the Pulse Driven Solenoid Valve (4). Separating
110 the power to the Pulse Driven Solenoid Valve (4) from the power for the Electronic
111 Logic Circuit (2) insures that the Electronic Logic Circuit (2) will not be at all affected by
112 the transients caused by the driving of the Pulse Driven Solenoid Valve (4). It is to be
113 noted that the pulse driven solenoid valves take considerable amount of power while
114 being pulsed and a capacitor of 1,000 uF or bigger may be needed to assist the power
115 module to provide the high current needed to trip the Pulse Driven Solenoid Valve (4).

116 Given the low power consumption achievable with the current electronic circuits
117 combined with the fact that the pulse driven solenoid valve consumes no power except
118 when being tripped, the power module can be designed to last five (5) or more years
119 before battery replacement is needed.

120 An alternative Power Module (3-A) using no batteries is shown on Fig. 3. In this
121 alternative option the Power Module (3-A) is constituted of a photovoltaic module and
122 three large capacitors (C1, C2 and C3) to store the energy needed to keep the circuits
123 operating throughout the night. In essence the capacitors are used as rechargeable
124 batteries, recharged on a daily basis by the photovoltaic module (SM1). Given the low
125 power used by the system a small solar module will be capable of recharging the
126 capacitors even in cloudy days. The alternative Power Module (3-A) is better suited if
127 the system is to be located in a region where replacement batteries are difficult to
128 obtain or the ambient temperatures are so extreme that using batteries is not
129 advisable.

130 As shown in Fig. 3, the high voltage capacitor (C1) is charged directly from the
131 solar module (SM1) and it will remain charged throughout the night as the blocking
132 diode (D1) prevents the current from flowing back. The charge stored on the high
133 voltage capacitor (C1) is for driving the pulse driven solenoid valve (4) and there is
134 virtually no discharging unless power is consumed to drive the solenoid valve (4) in the
135 event of a shutdown.

136 In contrast, the electronic logic module is continuously consuming some current
137 from the low voltage source (roughly 50 uA in current version) and it runs mainly on